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Unmanned Sea Surface Vehicle Electronic Warfare

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Introduction: The use of tactical unmanned vehicles provides a means to accomplish a wide variety of combat missions without risk to operators' lives and without loss of expensive platforms. In addition, these vehicles offer an opportunity to rapidly field advanced warfighting capabilities at relatively low cost simply by developing payload systems that seamlessly integrate with the vehicle's onboard control network. With the emergence of open control system standards, such as the Joint Architecture for Unmanned Systems (JAUS), the ability to build so-called plug-and-play payloads is approaching reality.

To exploit the opportunity of fielding advanced capabilities using unmanned platforms, the Tactical Electronic Warfare Division at NRL is developing an advanced electronic attack (EA) payload for surface ship defense that is suitable for unmanned vehicles like those planned for use with the Littoral Combat Ship. This development, sponsored by the Office of Naval Research, is designed to provide capabilities to counter late-generation sea surface surveillance and targeting radars found in maritime patrol aircraft and multi-role fighters, and to provide the capability to attack anti-ship missiles during their initial target survey scans. Used singly, the unmanned vehicles provide a long-duration self-protection countermeasure system. Used in multi-vehicle constellations, the unmanned vehicles with EA payloads can be used to provide an area defense capability over large sectors.

To demonstrate the utility of unmanned vehicles for surface ship defense, NRL has teamed with the Naval Sea Systems Command, Carderock Division, to integrate an electronic warfare (EW) payload onboard a sophisticated unmanned surface vehicle called the High Speed Unmanned Sea Surface Vehicle (HS-USSV). The HS-USSV is a remote-controlled 11 m hydrofoil, shown in Fig. 8. Its design provides a stable jamming platform that can maintain mission performance in high sea-state conditions and at speeds commensurate with large USN combatant ships.

USSV-EW System Overview: The EW payload for the HS-USSV leverages the wideband digital radio frequency memory (DRFM)-based EA system developed under the ONR Advanced Multifunction Radio Frequency (RF) Concept Future Naval Capabilities program. In addition to the standard playbook of jamming techniques, this DRFM-based system, shown in Fig. 9, has the capability to generate high-resolution false targets with realistic amplitude and Doppler modulations, engage multiple threats simultaneously, and generate sophisticated multi-component waveforms that combine false targets with various kinds of obscuration jamming. A novel, low-cost direction finding system has also been developed for the HS-USSV. High transmit power is achieved through use of high-gain antennas and high-power microwave power modules developed for tactical aircraft.

Payload command and control and system monitoring are provided by an interactive EW module developed for the NRL SIMDIS visualization tool shown in Fig. 10. SIMDIS provides operators with a real-time 3D visualization of platform positions and motions. The new EW module adds graphic representations of threat emitters as they are detected by the payload's electronic support receiver and EA engagement activity. Using a computer running SIMDIS with the EW module, operators can remotely control all payload functionality,

FIGURE 8
USSV during EW payload testing.

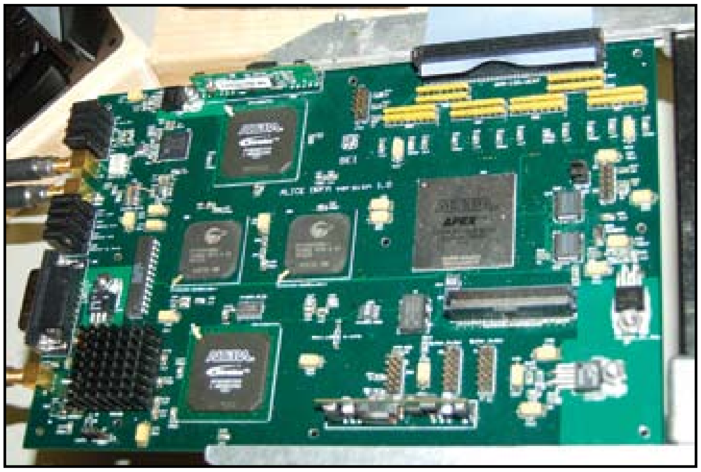

FIGURE 9
COTS-based digital RF memory (DRFM) waveform generator prototype.

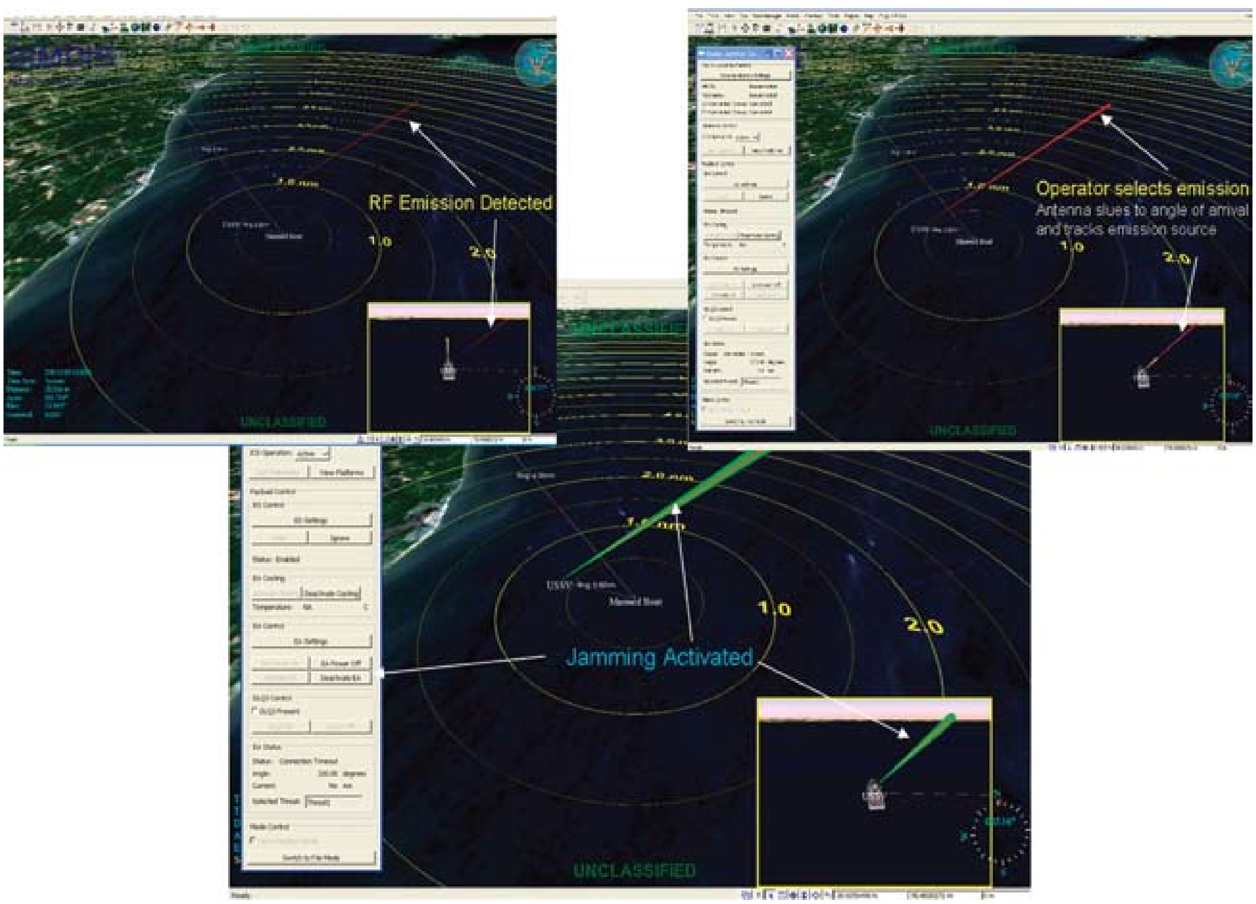

FIGURE 10
SIMDIS-based EW payload control interface. Top Left: Red beam denotes presence and direction of hostile RF emissions detections. Top Right: Operator selects RF transmission to be tracked by the EA antenna. Bottom: Operator activates EA against selected hostile emission.

specify search and threat parameters, and monitor the payload's activity. Payload control includes the capability to conduct preemptive jamming against known emitter locations, or reactive jamming against known threat emitters within designated geographic sectors. Friendly, neutral, and hostile RF signals are color-coded in the SIMDIS display to provide operators with rapid situational awareness. Any detected RF transmission within the bandwidth of the payload can be selectively tracked and jammed by the payload operator. Multiple payloads can be controlled by a single SIMDIS terminal, providing the capability to execute coordinated multi-vehicle EW concepts.

HS-USSV EW Experimentation: Experiments with the HS-USSV are planned through fiscal year 2008 to evaluate selected EA mission capabilities. These include operational deception to deceive synthetic aperture and inverse synthetic aperture radars, creating overwhelming numbers of decoy targets within an area to confuse airborne targeting platforms, and as a long-duration anti-ship missile (ASM) decoy.

The initial EA experiment was conducted in August 2006 and focused on the ASM decoy mission. Using a shore-based ASM simulator to track the ship target, the experiment examined the set of effective HS-USSV station positions that prevent the ASM seeker from successfully tracking the target vessel. The experiment revealed that a HS-USSV performing EA could deny ASM radar tracking of the target vessel using generic jamming waveforms. Additional experiments are planned for 2007 aimed at demonstrating other EA missions.

Summary: The use of unmanned surface and air vehicles is a promising avenue for delivering advanced electronic warfare capabilities to defend surface ships. The Tactical Electronic Warfare Division at NRL is aggressively developing EW payload technologies that provide low-cost, sophisticated electronic attack capabilities that can be rapidly transitioned to unmanned vehicles that utilize open architecture standards such as the Joint Architecture for Unmanned Systems. The effort is leveraging technologies developed under multiple ONR Future Naval Capabilities programs and NRL basic research programs to build a robust EW system with capabilities not currently found in the Fleet.

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